sary to study the rates of decomposition in equal and varying concentrations of actual nitrogen. It seems also that if practical conclusions are to be drawn, it is necessary to approximate field conditions, as nearly as possible, in laboratory tests. This point, it seems to the writer, has not been sufficiently recognized in many soil bacteriological studies. The conditions ensuing when relatively large amounts of nitrogenous substances such as dried blood, tankage, etc., undergo decomposition, may conceivably become extremely abnormal and greatly dissimilar to those ensuing under field practise. The products arising from the decomposition of 1 per cent. dried blood, under some conditions of bacterial activity may exert, either directly or indirectly, important influences on the further action of the micro-organisms present. Such, for example, is known to be the case in the bacterial decomposition of milk. In fact the course and extent of many chemical and biochemical reactions is known to be greatly modified by the products of the action.

As stated above, dried blood undergoes vigorous ammonification in the several plats studied. It has been suggested that the conditions produced by the high concentrations of ammonia or ammonium carbonate, formed from the larger amounts of dried blood and bone meal, may have been unfavorable to the activity of the nitrifiers. With the hope of securing light on this point, preliminary studies have been made by adding varying amounts of ammonium hydrate and ammonium carbonate in addition to 0.25 per cent. dried blood, using a soil in which no nitrification of 1 per cent. dried blood takes place. The results showed that in every case the addition of either ammonium hydrate or ammonium carbonate partially inhibited nitrification even in the low concentration of 5 mg. per 100 gm. soil. Whether the ammonia was actually toxic to the nitrifying organisms, or reacted unfavorably through physical effects produced or otherwise, can not be definitely stated at the present time.

Evidence has been obtained that there is considerable seasonal variation in regard to the inhibiting effect of 1 per cent. dried blood. With samples drawn from one plat in April and June, respectively, 1 per cent. dried blood underwent active nitrification, while no nitrification took place in samples taken August 14. In each case 0.5 per cent. and less were actively nitrified. Whatever may be the cause of this phenomenon, the fact still remains to be explained that 1 per cent. dried blood brought about toxic conditions in certain plats, but not pronouncedly so in others.

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SOME EXPERIMENTS WITH AGENTS CALCULATED TO KILL THE TROMBIDIUM HOLOSERICEUM

THE *Trombidium holosericeum* or common chicken mite is present in most hen houses throughout the country. It is very troublesome in the hotter months, especially July and August, when it finds climatic conditions favorable for its more rapid multiplication. The mites hide in clusters, in the cracks and crevices of the roost pole and in the crack where the roost pole rests on its support. Here they lay their eggs and the young and old emerge to attack the chickens at night.

The mite finds its way to the hen at night and with its conical piercing apparatus attacks the skin and draws blood. After its feast it leaves the hen and returns to its hiding place.

In searching the literature at hand in the library of the office of poultry investigations and pathology of this station no trace could be found where scientific tests and records had been made to determine just what effect the various parasiticides have upon mites.

There is common belief that tobacco clippings, sulphur, paris green, and a host of liquids are great destroyers of these formidable foes of the poultry house, but no one so far as we could find has actually made the tests. It was thought best to try a score of the more common agents used and to run duplicate tests.

Mode of Tests.—The tests were run either in open tumblers or sauce dishes so as to have an abundance of air present and to have the

tests as nearly under normal conditions as possible.

Agents Used.—The agents used fall into three classes, namely: Powders not giving off gas, powders that give off gases, and liquids. Tests were run with sulphur, air-slaked lime, paris green, naphthalene, gasoline, carbolic acid, insect powder, tobacco stems and dust, crude carbolic acid, 5 per cent. carbolic acid, 1 per cent. kreso dip, 2 per cent. kreso dip, 5 per cent. naphthalene in kerosene and 10 per cent. formaldehyde.

Sulphur.—Air-slaked lime was placed in the bottom of a tumbler. At the end of 24 hours, the mites had accumulated in a cluster in the center of the dry lime. Upon being poured out upon a paper they were still found to remain vigorous. Dry air-slaked lime has apparently no injurious effect upon them.

Paris Green.—Dry paris green (powder) was placed in the bottom of a tumbler and several hundred mites placed in the powder and stirred up. At the end of 48 hours the mites had formed in a cluster in one edge of the powder. Upon being removed they were found to be as vigorous as before being placed in the paris green. Dry paris green has apparently no ill effect upon mites.

Naphthalene (Powdered Moth Balls).—A quantity of pulverized moth balls was placed in the bottom of a tumbler and several hundred vigorous mites placed on the surface. At the end of 30 minutes motion was not so active and at the end of 45 minutes all motion ceased. Upon being removed and placed upon paper all mites were found to be dead.

Tobacco Bits.—Bits of tobacco leaves, the sweepings from the floor of a tobacco factory, were placed in the bottom of a tumbler and several hundred very active mites placed among the tobacco. Frequent observations were made and at the end of 72 hours the mites were as active as when they were placed in the tumbler.

Insect Powder.—A powder prepared in this laboratory consists of gasoline three parts, crude carbolic acid 1 part, and plaster of paris sufficient to make a rather dry mixture. This was passed through a sieve on to paper and after one hour was placed in tight jars till needed. A quantity of this powder was placed in the bottom of a tumbler and several hundred active mites placed in the material and mixed with it. At the end of one minute all mites were dead.

Five Per Cent. Carbolic Acid Solution in Water.—A quantity of a five-per-cent. aqueous solution of carbolic acid was poured out into a saucer and several hundred mites placed on one side, and the dish then tilted till all the mites were wet, then the liquid drained from them, the mites remaining on the wet surface for observation. In 30 seconds all mites were dead.

One Per Cent. Naphthalene in Kerosene.—One per cent. powdered moth balls dissolved in kerosene was tested. A quantity of this fluid was poured into a saucer and several hundred mites placed on the opposite side of the saucer then immersed as in the preceding test. In 30 seconds all mites in test were dead.

Crude Carbolic Acid.—Crude carbolic acid was poured into a saucer and several hundred mites placed on one side were immersed as in the preceding test. In 20 seconds all mites in the test were dead.

One Per Cent. Kreso Dip.—This liquid was poured into a saucer and several hundred mites subjected as in the preceding tests. At the end of four minutes motions slowed and at the end of ten minutes all mites in the test were dead.

Two Per Cent. Kreso Dip.—Test conducted as the preceding. At the end of two minutes motion was retarded and all mites in the test were dead at the end of four minutes.

Ten Per Cent. Formaldehyde.—The test was conducted as in the preceding. At the end of ten minutes all the mites in the test were dead.

Summary

Duplicate tests were run to determine the action, if any, of powdered sulphur, air-slaked lime, paris green and naphthalene upon the *Trombidium holosericeum* (the chicken mite).

It was found that though sulphur in solution as in lime and sulphur dip is an efficient parasiticide, that although paris green in solu-

tion is a violent poison because of its arsenic content and although tobacco leaves contain nicotine which when in solution is an effective parasiticide, yet these agents in their dry state do not destroy mites.

Duplicate tests were run with naphthalene or powdered moth balls which on account of its volatile substances emitted, killed all mites in the tests in 45 minutes.

Insect powder containing gasoline and crude carbolic acid, on account of the volatile substances given off, killed all mites in one minute.

In duplicate tests, solutions sufficiently concentrated killed in the following lengths of time: Crude carbolic acid, 20 seconds. Five per cent. carbolic acid, one minute. One per cent. naphthalene in kerosene, 30 seconds. One per cent. kreso dip ten minutes and two per cent. four minutes. Ten per cent. formaldehyde ten minutes.

Conclusions

In order that parasiticides be effective in the destruction of the mites they must either be in solution or be capable of giving off volatile substances which in themselves are destructive.

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THE GROWTH OF BONE IN CRETACEOUS TIMES

PALEONTOLOGISTS have, for many years, been acquainted with the curious conical portions of young plesiosaurian propodials and, also, they have observed definite openings on the edges of many of the flattened limb bones. One of these openings has, in some cases, been observed to lead into a canal, which, in turn, passes into a cavity, remarkably like the medullary canal of mammalian long bones. There has never been an adequate explanation for these curious conditions.

It has been generally assumed that the unusual characters mentioned above have been confined to the propodium (humerus or femur) but, recently, in studying the osteology of an immature plesiosaur from the Cretaceous, the writer noted all of these characters in a phalangeal bone. Further study of this problem will doubtless result in the discovery of these characteristics in all the long bones of the skeleton, especially in young and immature animals.

Andrews, Williston, Lydekker, Kiprijanoff and the writer have remarked on the unusual characters of this ancient group of aquatic reptiles and an attempted explanation[1] has been given of the curious conical ends of young propodials which formerly were regarded as epiphyses.

In regard to the openings, canal and cavity, the writer believes an adequate explanation of this condition is to be found in the developmental history of the mammalian long bones. Szymonowicz[2] has figured in a developing long bone of a mammal an opening which he terms "periosteal bud," similar in all respects to the opening in the edge of plesiosaurian limb bones. In both cases a canal leads from the foramen into the medullary cavity.

Jackson[3] has given a careful description and figure of a similar condition in the tibia of a three-day cat. Through this opening the blood vessels supplying the medullary cavity, the osteoblasts and marrow-forming elements migrate from the periphery into the medullary cavity.

Bidder[4] has further studied the conditions of bone formation and his contribution has suggested an explanation for certain curious features in the propodials of the plesiosaurs. The question arises as to whether it is legitimate to interpret developmental factors in the ancient reptiles from what occurs in modern mammals. That question is not yet settled, but assuming that an analogy may be safely drawn between developmental features in the

[1] Moodie, Roy L., "Reptilian Epiphyses," *Amer. Jour. Anat.*, Vol. 7, No. 4, pp. 443–467, Figs. 1–24, 1908.

[2] Szymonowicz, L., "A Text-book of Histology and Microscopic Anatomy of the Human Body," trans. by MacCallum, 1902, p. 270, Plate XXIX.

[3] Jackson, C. M., *Archiv für Anat. u. Physiol., Anat. Abth., Jahrg.*, 1904, p. 33, Taf. VII., Fig. 1.

[4] Bidder, Alfred, 1906, "Osteobiologie," *Archiv f. mikros. Anat.*, Bd. 68, pp. 137–210, Taf. X–XIV.